

REMARKS

Claims 16-20, 22, 24, 30 and 32-37 are currently pending in this application. Claims 23 and 31 have been cancelled without prejudice or disclaimer. Claims 36 and 37 have been allowed and claims 16-20, 22, 24, 30 and 32-35 stand rejected.

Claim Rejections

Claims 16-20, 22-24 and 30-35 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,672,811 to Kato (hereinafter referred to as “Kato ‘811”) in view of U.S. Patent No. 5,676,811 to Makino, *et al.* (“Makino”). Claims 16-20, 22-24 and 30-35 also stand rejected under 35 U.S.C. §103(a) as being unpatentable over JP 10-38845 (hereinafter referred to as “JP ‘845”) or U.S. Patent No. 6,036,841 to Kato (hereinafter referred to as Kato ‘841) in view of U.S. Patent No. 5,676,811 to Makino.

Claims 16-20, 22, 24 and 30

Claims 16 and 30 of the present application recite that the both the positive electrode and the negative electrode comprise porous platinum and have different areas. Accordingly, in the invention as claimed in claims 16 and 30, both the positive electrode and the negative electrode are made of the same material. Additionally, claims 16 and 30 also recite that the area of the positive and the negative electrodes differ. Therefore, in the claimed invention the area of the positive and negative electrodes differ even though they are both made of the same material. Applicants submit that these claims are allowable over the Examiner’s rejection at least because

of the particular combination of features set forth in the claimed invention including positive and negative electrodes including porous platinum and having different areas.

In contrast to the claimed invention, Kato '811 teaches electrodes that are the same size being made of the same materials. Particularly, Kato '881 teaches an embodiment, as shown in Fig. 2, in which electrodes 22 and 24 are made of the same material and electrode 28 is made of a different material than electrodes 22 and 24 (*see*, column 12, lines 11-17 and lines 34-39). As shown in Fig. 2, the electrodes 22 and 24 are the same size. Thus, in the Kato '811 embodiment, the electrodes which are made of the same material (22 and 24) are the same size. This contrasts with the claimed invention in which the positive and negative electrodes are made of the same material even though their respective areas differ.

That is, Kato '811 fails to disclose a sensor element having negative and positive electrodes disposed on the same side of a solid electrolyte substrate, each of which comprises porous platinum yet having different areas. Furthermore, the prior art fails to teach or suggest the advantages attendant thereto, namely, reduced resistance. Moreover, there is nothing in the prior art which suggests that it is desirable to employ such an electrode arrangement. Accordingly, Applicants submit that claims 16 and 30 are allowable.

Claims 17-20, 22 and 24 depend from claim 16 and Applicants submit that they are therefore allowable at least because of their dependency.

Claims 32-35

Claims 32-34 all recite that the area of a first electrode is at least two-fold larger than that of the second electrode, and are allowable over the Examiner's combination of references at least because the Examiner's combination fail to teach or suggest a device with this feature. Claim 35 depends from claim 34 and is allowable at least because of its dependency.

Fig. 2 of Kato '811 is cited by the Examiner as showing electrode 28 having a side edge longer than twice that of electrode 24. Accordingly, if both electrodes are presumed to have the same width, electrode 28 would have an area more than twice that of electrode 24. The Examiner relies on Fig. 2 of Makino as showing that it was known in the art to extend the electrodes of a gas sensor over the entire width range of a given chamber (citing electrode 8 and reference electrode 13). The reason for rejection is that it would have been obvious to extend electrodes 28 and 24 over the entire width of their respective chambers as taught by Makino, in order to (i) provide maximum surface area and thereby reduce effective resistance, (ii) increase the magnitude of diffusion control, (iii) allow more sample to be analyzed per unit time, and (iv) prevent localization of NOx concentration.

Applicants respectfully traverse this rejection in view of the following arguments. The combination of Kato '811 and Makino fail to teach or suggest each and every claim limitation.

Yet, to establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art.¹

The invention of claims 32-35 require the area of the negative electrode and the area of the positive electrode to differ by at least two-fold. This is a requirement of the claims. The obviousness determination centers on whether there is something in the prior art (or in knowledge generally available to one of ordinary skill) that suggests the desirability, and hence the obviousness, of arranging negative and positive electrodes on the same side of a solid electrolyte substrate, where there respective areas differ by at least two-fold.

It is respectfully submitted that (1) the Examiner is not entitled to make a presumption about the length of the Kato electrodes, (2) nothing in Kato gives any indication that the electrodes are of the same width, and (3) it would not have been obvious to modify Kato to provide electrodes of the same width.

A) Kato '811 does not teach anything regarding the relative areas of the positive and negative electrodes

Initially, there simply is no disclosure or illustration in Kato '811 as to the two-dimensional size of or relative area of electrodes 28 and 24. No information regarding relative electrode area may be determined, one way or the other, from Figs. 1 and 2 of Kato '811.

¹ *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974).

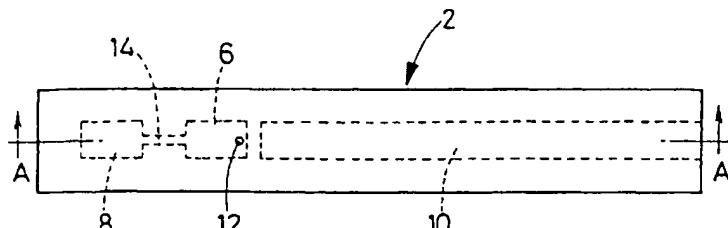


FIG. 1

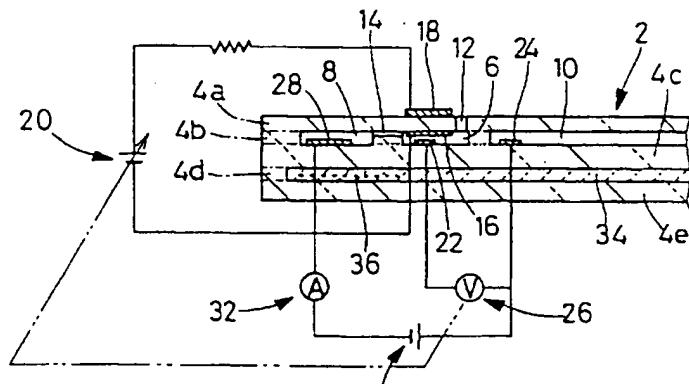


FIG. 2

Fig. 2 of Kato '811 which shows a cross-section taken along line A-A of Fig. 1 says nothing about the relative areas of electrodes 28 and 24.

As described at column 9, lines 39-41, Fig. 2 of Kato '811 shows a cross-section taken along line A-A of Fig. 1 - which does not represent the relative electrode areas. There is no teaching or suggestion that the widths of electrodes 28 and 24 are the same. Furthermore, there is nothing in the specification of Kato '811 which further describes these electrodes in a manner that would allow for determining their relative areas. Moreover, there is nothing in Kato '811 that describes any advantage of making the area of electrode 28 at least two-fold that of electrode

24, and Kato '811 is entirely silent with respect to the relationship between electrode area ratio and element resistance.

B) It is improper to rely on the proportions of drawings which are not to scale

The Examiner improperly relies on the proportions of the Kato '811 drawings. Kato '811 does not state that the drawings are to scale. When drawings are not to scale proportions of features in a drawing are not evidence of actual proportions.² Yet, the Examiner's sole argument for the prior art teaching the claimed areas is the Kato drawings '811 which are not to scale. Since the Examiner's position that the electrode 28 is at least twice as long as electrode 24 is based solely on drawings that have not been indicated as drawn to scale, the Examiner's position is improper. Accordingly, even if the Kato electrodes did have the same width, because the Examiner's basis for their difference in length is improper, the cited references still would not teach the claimed relative electrode areas.

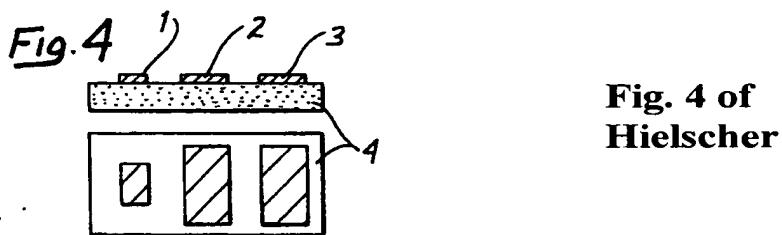
C) Kato '811 does not disclose electrode widths

Kato '811 also does not disclose negative and positive electrodes disposed on the same side of the support and having an area differing by at least two-fold because it lacks any teaching about the electrode widths. None of the drawings or disclosure of Kato '811 illustrates or

² See, for example, MPEP §2125, and *Hockerson-Halberstadt, Inc. v. Avia Group Int'l.*, 222 F.3d 951, 956 (Fed. Cir. 2000).

otherwise discloses or describes the width of the respective electrodes. Rather, the Examiner *infers* that such arrangement would have been rendered obvious in view of Makino. However, how can that be when there is no disclosure in Makino of negative and positive electrodes having an area differing by at least two-fold as claimed.

For example, a copy of the first two cover pages of U.S. Patent 5,403,452 to Hielscher, *et al.* ("Hielscher") was submitted on August 21, 2003, to illustrate that the widths of electrodes may differ when cross-sectional views, such as that in Kato '811 are used. Fig. 4 of Hielscher shows the situation where the cross-section (upper figure - showing the electrode side edge) provides no information regarding the electrode area (lower figure). That is, the vertical dimension of electrode 1 is much shorter than that of electrode 2, which information is not reflected in the upper cross-section.



Furthermore, Applicants provided a marked-up copy of Figs. 1 and 2 of U.S. Patent No. 5,672,811 to Kato on August 21, 2003. The marked-up drawings show that because of the narrow width of the diffusion controlling passage 14, electrode 28 would be selected to have a

correspondingly narrow width as shown. Conversely, electrode 24 opposing electrode 16 may extend along substantially the entire width of the chamber 10. In this configuration, it is clearly seen that the area of the negative electrode and the area of the positive electrode would not differ by at least two-fold as claimed. This is but one example of how the electrodes might be arranged in Kato '811. More importantly, Fig. 2 of Kato '811 is only a cross-sectional view, and therefore does not teach, disclose or suggest in any manner way shape or form the surface area of the electrodes.

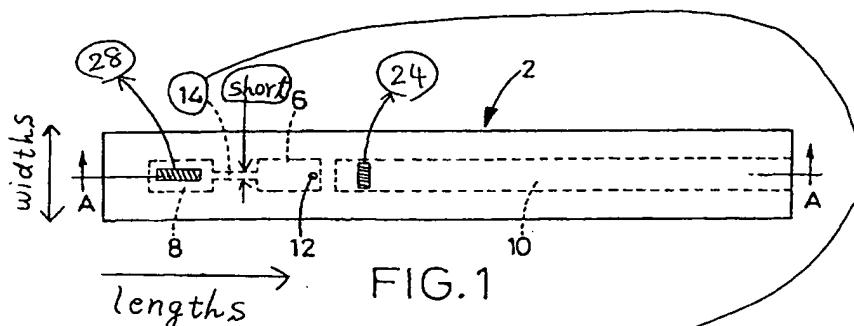


FIG. 1

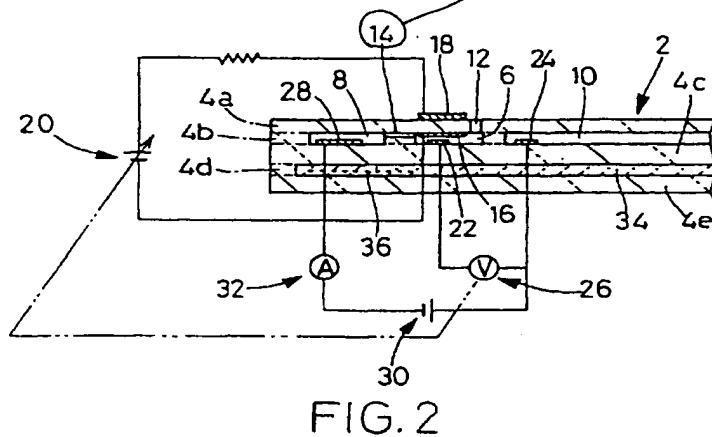


FIG. 2

Applicants' marked-up drawings of Figs. 1 and 2 of Kato '811

D) Makino also fails to teach the claimed difference between the areas of the positive and negative electrodes

The Examiner attempts to correct the deficiencies of Kato with Makino, but this reference also fails to teach anything regarding relative electrode area. Makino shows coupled electrodes 12 and 13 of roughly the same area disposed on the same side of solid electrolyte 35 and extending over a portion of the width of the electrolyte. Electrode 8 cannot be compared with electrode 13 as suggested by the Examiner because they are not coupled (i.e., the claims require applying an electric potential between the negative electrode and the positive electrode). Rather, electrodes 7 and 8 form an oxygen pump with electrolyte layer 35 arranged therebetween. Nowhere does Makino disclose, teach or suggest a negative electrode and positive electrode disposed on the same side of a solid electrolyte substrate and having an area differing by at least two-fold. In Fig. 2 of Makino, electrodes 7 and 8 together with substrate 35 form pump cell 2, whereas electrodes 12 and 13 in chambers 17 and 19, respectively, form oxygen sensor portion 3. Namely, electrodes 7 and 8 of Makino correspond to the claimed negative and positive electrodes. See, for example, present claim 30, wherein the negative and positive electrodes are arranged so as to pump oxygen from the negative electrode to the positive electrode, the sensor comprising a circuit for applying an electric potential between the negative and positive electrodes such that a pump current flows therebetween when the sensor is used for detecting the amount of a gas.

The present claims further require that the negative and positive electrodes are disposed on the same side of a solid electrolyte substrate, but this characteristic feature of the present invention is neither disclosed nor illustrated in any of Figs. 1-23 of Makino. That is, electrodes 7 and 8 of Makino are disposed on opposite sides of solid electrolyte sheet 35. Also, the figures of Makino show electrodes 7 and 8 as having the same area. Therefore, rather than teaching electrodes with different areas, as claimed, Makino teaches electrodes with the same area.

E) One of ordinary skill in the art would not have modified Kato with Makino and any combination would still be deficient at least because neither reference teaches the claimed difference between the areas of positive and negative electrodes.

One of ordinary skill in the art would not have been motivated to modify the Kato '811 electrodes to have different areas based on Makino's teachings, at least because Makino does not teach electrodes of different areas. Instead, Makino teaches electrode which appear to be roughly of the same area.

Furthermore, electrodes 12 and 13 forming oxygen sensor portion 3 in Makino do not correspond to the negative electrode and positive electrode as claimed in the present application. Even if the Examiner did consider electrodes 12 and 13 forming oxygen sensor portion 3 in Makino to correspond to the claimed negative and positive electrodes, electrodes 12 and 13 are of the same area.

Fig. 2 of Kato '811 similarly differs from Makino in that electrode 28 relied upon as having a side edge longer than twice that of electrode 24, and corresponding to the claimed

negative and positive electrodes, respectively, are arranged on the same side of the support. It is, therefore, respectfully submitted that there is nothing in the cited prior art which would lead one of ordinary skill to modify the electrode configuration of Kato '811 so as to extend over the entire width range of a given chamber due to the above-noted differences in configuration and arrangement. More particularly, because the structure of the sensor of Makino so much differs from that of Kato '811, the considerations for arranging the electrodes in Makino do not apply to Kato '811. Surely, Makino is silent with respect to relative electrode area, and has no explanation as to why the electrodes shown therein should extend over the entire width of their respective chambers.

In Figs. 1 and 2 of Kato '811, measurement gas is introduced into first internal space 6 through passage 12. Second internal space 8 communicates with first internal space 6 via second diffusion controlling passage 14. Thus, it makes sense to arrange electrode 28 along the axis of the gas flow. Kato '811 does not disclose negative and positive electrodes provided on the same side as the support and having an area differing by at least two-fold as claimed. The only way that the Examiner arrives at this conclusion is by setting the electrodes in Kato '811 to extend over the entire chamber width as shown in Makino. However, Applicant has also cited sensor art which shows to the contrary, namely, electrodes of varying width shown in Fig. 4 of U.S. Patent 5,403,452 to Hielscher, as discussed above. In other words, the state of the art is such that

electrodes are not uniformly extended over the entire width of the their respective chambers as suggested by the Examiner.

On the other hand, measurement gas in Makino is introduced into chamber 17 via communication hole 9, and air passage 19 serves as an oxygen reference (through opening 20). Unlike Kato '811, Makino does not have a two-chamber structure including flow of measurement gas from a first chamber to a second chamber. Namely, there is no "gas flow" as in the sensor of Kato '811, such that there is no reason to arrange an electrode along the axis of gas flow as suggested for the case of Kato '811.

Regarding this last point, assuming *arguendo* that one of ordinary skill would find sufficient reason to arrange an electrode along the axis of gas flow, the combination of Kato '811 and Makino still does not teach the desirability, and hence the unobviousness, of adjusting the area of the negative electrode and the area of the positive electrode such that they differ by at least two-fold. Moreover, although Makino shows the electrodes extending over the entire width of the respective chambers, there is no disclosure in Makino as to why such electrode arrangement would be advantageous. The reasons (i) to (iv) above advanced by the Examiner are speculative and nowhere found in the prior art. Applicants, therefore, dispute that reasons (i) to (iv) constitute knowledge generally available to one of ordinary skill in the art (so as to allow for combination and/or modification of the cited references).

Furthermore, the combination of Kato '811 and Makino still does not teach or suggest all of the limitations of the rejected claims, including the requirement that the area of the negative electrode and the area of the positive electrode differ by at least two-fold. Particularly, the Examiner is taking a drawing from Makino, showing electrodes extending over the entire width of the chamber, and reasons that it would likewise have been obvious to extend the electrodes of Kato '811 over the entire width of the chamber. However, there is nothing in the cited prior art as to why it would be desirable to employ such an electrode arrangement, or why such electrode arrangement should be applied to the sensor of Kato '811 having a two-chamber structure entirely different from that of the sensor of Makino.

By applying Makino to Kato '811, the Examiner arrives at a modified sensor said to inherently have an area of the negative electrode and area of the positive electrode differing by at least two-fold. However, this does not teach the subject limitation of the present claims, or the advantages thereof and one of ordinary skill in the art could not have arrived at such an arrangement in the absence of Applicants' teachings in the specification. Absent the discovery of reduced resistance when the area ratio is set as defined by the present application, there would have been no motivation for one of ordinary skill in the art to make the claimed invention.

For the above reasons, it is respectfully submitted that the present claims are allowable over Kato '811 in view of Makino. Additionally, JP '845 and Kato '841 are similar disclosures, and the Examiner's application of Makino to JP '845 or Kato '841 also suffers from the same

deficiencies as outlined above. Accordingly, Applicants respectfully request that the Examiner withdraw the foregoing rejections of claims 32-35.

Claims 23 and 31

Claims 23 and 31 have been cancelled, rendering their rejection moot.

Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees (except the Issue/Publication Fees) to our Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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